Phosphorus Best Management Practices
Protecting Water Quality

Lake and Pond Treatment by Nutrient Inactivation

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Definition:

The use of chemical precipitants to bind soluble reactive phosphorus (SRP) into an insoluble form that is unavailable to algae and clarify the water column.

Purpose:

To prevent eutrophication or rehabilitate those bodies of water considered eutrophic due to high concentrations of SRP.

How Does This Practice Work?

Aluminum sulfate (alum) is dispensed in carefully controlled amounts to the affected water body. The aluminum reacts with the SRP to form aluminum phosphate that is insoluble at pH values between 3 and 9.

Additionally, the aluminum undergoes hydrolysis to form aluminum hydroxide floc that clarifies the water column and adsorbs additional phosphorus (P).

The aluminum hydroxide precipitate, and floc settle to the bottom of the lake or pond, forming a thin film over the sediment. This thin film decreases P release and recycling from bottom sediments.

Where This Practice Applies and Its Limitations:

Alum treatment of lakes, ponds and reservoirs is a common practice. The first lake was treated in 1970, and more than 200 have been treated since.

The application can be a single dose determined to inactivate the water column SRP or to prevent P recycling from deposited bottom sediments. In several states, alum is injected proportional to storm flow for urban and sub-urban stormwater and edge-of-field runoff in agricultural site remediation.

Large water bodies are typically treated with liquid alum by experienced applicators and limnologists, using computer and GPS-guided vessels. These boats have the ability to add buffering agents as needed.

Smaller lakes and ponds can be treated with dry alum.

Alum will depress the pH of the water. It is established practice to maintain the water pH between 6 and 7.5 during treatment. If the receiving water is already low pH or low alkalinity, buffered alum will be better. Other alkalis like sodium aluminate at two gallons of alum + one gallon of sodium aluminate are effective in treating P without adversely impacting pH.

Check with the manufacturers or a qualified water-treatment specialist before treating lakes, ponds or reservoirs. A critical component of the success of this practice is accurate and complete water quality determinations for pH, alkalinity and P. The size and volume of the subject pond or lake must be accurately determined. Influent water quality and volume and sediment characterizations are also important to ensure accurate dosage of the precipitants and any buffering agents.

Effectiveness:

Lake and pond nutrient inactivation treatment will reduce algal numbers and clarify water. In deeper lakes the oxygenated water depth increases, making a larger volume of water suitable for game fish.

For severely polluted waters, an algaecide may be needed to kill the algae and get the P in the algae bodies into the bottom where the alum can inactivate the SRP.

If further inputs of P to the lake or pond are

managed, nutrient inactivation can last 10 to 20 years. Many lakes treated in the 1970s and 1980s that had Best Management Practices established in their watershed are still clean. Lakes with large, uncontrolled nutrient inputs may need routine re-treatment or on-demand application systems, in addition to attempts to decrease P inputs.

Cost of Establishing and Putting the Practice in Place:

The cost of a nutrient inactivation program will depend on the size of the water body; degree of pollution; water chemistry and need for buffering agents; site access, if application contractors are used; consulting fees, if needed; and freight from the chemical manufacturing plants.

For more complex applications, costs for chemicals and application may vary from a few hundred dollars per acre to more than a thousand dollars per acre.

On-demand application systems will vary widely depending on need for buffering agents and a separate feed control system, cost of land, size and cost of building, electronic control sophistication, design and consulting and delivered chemical costs.

Operation and Maintenance:

Maintenance of nutrient inactivation programs is mostly water quality monitoring to make sure additional SRP inputs are controlled. Periodic tests for pH, alkalinity, total and soluble P, chlorophyll a and turbidity/transparency will aid the assessment of effectiveness and longevity of treatment.

On-demand systems will require preventative maintenance of the dosing and control systems. Pumps utilized for this application are similar to those used in disinfectant applications in dairy systems or medication pumps used in broiler houses.

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For Further Information:

Contact your local conservation district, USDA-NRCS or Cooperative Extension Service office. Additional information may be obtained from the North American Lake Management Society at www.NALMS.org and local water-treatment chemical manufacturers.